TABLE 2.—*Tabulated data*—Continued

OCTOBER 28, 1927

| Time 90th mer. | Altitude, M. S. L. | Pressure | Temperature | $\frac{\Delta t}{100\text{ m.}}$ | Humidity: Relative | Humidity: Vapor pressure | Wind: Direction | Wind: Velocity | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| P. m. | *M.* | *Mb.* | *°C.* | | *P. ct.* | *Mb.* | | *M. p. s.* | |
| 4:03 | 141 | 999.3 | 28.2 | | 33 | 12.63 | ssw. | 5.4 | 4 Ci. WNW. |
| | 250 | | 27.2 | | | | ssw. | 6.0 | |
| | 500 | 959.8 | 24.8 | | | | s. | 7.1 | Clear until 4 p. m. |
| | 750 | | 22.5 | | | | s. | 7.6 | |
| | 1,000 | 905.9 | 20.1 | | | | sse. | 7.6 | |
| 4:06 | 1,181 | 887.0 | 18.4 | 0.94 | | | sse. | 7.4 | Adiabatic. |
| | 1,250 | | 17.7 | | | | sse. | 7.4 | |
| | 1,500 | 854.8 | 15.1 | | | | s. | 6.8 | |
| | 2,000 | 805.0 | 10.0 | | | | s. | 7.4 | |
| 4:10 | 2,034 | 801.7 | 9.7 | 1.02 | | | s. | 7.6 | Superadiabatic. |
| 4:11 | 2,331 | 773.5 | 9.1 | 0.20 | | | s. | 9.0 | |
| | 2,500 | 758.0 | 8.1 | | | | s. | 9.8 | |
| | 3,000 | 713.3 | 5.1 | | | | s. | 10.0 | |
| | 3,500 | 671.0 | 2.0 | | | | s. | 9.6 | |
| 4:16 | 3,652 | 658.3 | 1.1 | 0.61 | | | s. | 8.2 | |
| | 4,000 | 630.5 | 0.5 | | | | ssw. | 3.9 | |
| 4:19 | 4,194 | 615.3 | 0.1 | 0.18 | | | sw. | 3.2 | |
| | 4,500 | 592.4 | −1.9 | | | | wsw. | 3.2 | |
| 4:20 | 4,679 | 579.3 | −3.0 | 0.64 | | | wsw. | 3.4 | |
| | 5,000 | 556.7 | −3.6 | | | | wsw. | 2.9 | |
| 4:22 | 5,203 | 542.5 | −4.0 | 0.19 | | | wnw. | 2.6 | |
| | 6,000 | 490.2 | −9.8 | | | | w. | 5.8 | |
| 4:27 | 6,585 | 454.4 | −14.0 | 0.72 | | | w. | 4.8 | |
| | 7,000 | 430.0 | −17.6 | | | | w. | 3.6 | |
| 4:32 | 7,605 | 396.4 | −22.9 | 0.87 | | | wsw. | 4.2 | |
| | 8,000 | 376.2 | −26.5 | | | | wsw. | 4.8 | |
| 4:36 | 8,610 | 345.6 | −32.1 | 0.92 | | | w. | 3.8 | Adiabatic. |

OCTOBER 30, 1927

| Time 90th mer. | Altitude, M. S. L. | Pressure | Temperature | $\frac{\Delta t}{100\text{ m.}}$ | Humidity: Relative | Humidity: Vapor pressure | Wind: Direction | Wind: Velocity | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 3:51 | 141 | 995.6 | 19.6 | | 78 | 17.80 | wnw. | 11.6 | 8 A. St., SW.; 2 St. Cu.; NW (?). |
| | 250 | | 18.9 | | | | | | |

TABLE 2.—*Tabulated data*—Continued.

OCTOBER 30, 1927—Continued

| Time 90th mer. | Altitude, M. S. L. | Pressure | Temperature | $\frac{\Delta t}{100\text{ m.}}$ | Humidity: Relative | Humidity: Vapor pressure | Wind: Direction | Wind: Velocity | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| P. m. | *M.* | *Mb.* | *°C.* | | *P. ct.* | *Mb.* | | *M. p. s.* | |
| 3:15 | 500 | 954.8 | 17.3 | | | | | | Clear to 10 a., then cloudy to 6 p. |
| 3:53 | 564 | 947.8 | 16.9 | 0.64 | | | | | |
| | 750 | | 16.9 | | | | | | |
| 3:54 | 940 | 907.0 | 16.9 | 0.00 | | | | | Isothermal. |
| | 1,000 | 900.8 | 16.5 | | | | | | |
| | 1,250 | | 14.8 | | | | | | Thunder first heard at 3:05 p.; last heard DNp. R. B. 3:18 p. E. DNa. 31 st. |
| | 1,500 | 849.5 | 13.2 | | | | | | |
| | 2,000 | 800.0 | 9.8 | | | | | | |
| 4:00 | 2,125 | 787.7 | 9.0 | 0.67 | | | | | |
| | 2,500 | 752.0 | 6.0 | | | | | | |
| | 3,000 | 707.7 | 2.0 | | | | | | |
| 4:05 | 3,326 | 680.1 | −0.6 | 0.80 | | | | | |
| | 3,500 | 665.9 | −1.5 | | | | | | |
| | 4,000 | 626.0 | −4.0 | | | | | | |
| | 4,500 | 587.4 | −6.6 | | | | | | |
| 4:10 | 4,823 | 563.1 | −8.2 | 0.51 | | | | | |
| | 5,000 | 550.3 | −8.9 | | | | | | |
| 4:14 | 5,699 | 502.8 | −11.7 | 0.40 | | | | | |
| | 6,000 | 483.9 | −14.3 | | | | | | |
| | 7,000 | 424.4 | −22.8 | | | | | | |
| 4:23 | 7,532 | 393.8 | −27.4 | 0.86 | | | | | |
| | 8,000 | 368.9 | −31.2 | | | | | | |
| | 9,000 | 320.6 | −39.1 | | | | | | |
| 4:32 | 9,152 | 314.0 | −40.3 | 0.80 | | | | | |
| | 10,000 | 279.3 | −47.1 | | | | | | |
| | 11,000 | 241.3 | −55.1 | | | | | | |
| 4:44 | 11,853 | 209.5 | −62.0 | 0.80 | | | | | Base of stratosphere. |
| | 12,000 | 204.9 | −61.7 | | | | | | |
| | 13,000 | 175.0 | −59.6 | | | | | | |
| 4:56 | 13,636 | 158.9 | −58.2 | −0.21 | | | | | |
| | 14,000 | 150.4 | −59.6 | | | | | | |
| | 15,000 | 128.2 | −63.4 | | | | | | |
| 5:06 | 15,019 | 127.9 | −63.5 | 0.38 | | | | | |

# THE PASSING OF SIGNAL SERVICE, WEATHER BUREAU ELECTRIC TELEGRAPH AND CABLE SYSTEMS

551.507

ALFRED J. HENRY

In Weather Bureau Topics and Personnel for May, 1929, the following paragraph appears:

> The WEATHER BUREAU's telegraph lines between Cape Henry, Va., and Hatteras, N. C., and between Port Angeles and Tatoosh Island, Wash., the short telegraph line between North Head and Fort Canby, Wash., and the telephone cable between Beaver Island and Charlevoix, Mich., will be transferred to the Coast Guard at the termination of June 30, 1929.

The above order marks the concluding chapter of the period of construction, ownership, and operation by the Signal Service and its successor, the WEATHER BUREAU, of electric telegraph lines and submarine cables for the purpose of obtaining weather reports from and issuing storm warnings to isolated points in various parts of the United States. A brief history of this special activity is presented in the following paragraphs:

In the early seventies the newly organized Signal Service of the Army, having been commissioned by Congress to organize a storm reporting and warning service for the benefit of commerce and navigation, was confronted with the problem of finding ways and means of reaching places not already linked up with any of the existing commercial telegraph or telephone systems. It should also be kept in mind that the Signal Service was a unit in the regular Military Establishment of the country and that one of its functions as such was to provide and maintain prompt communication between the frontier military posts of the Southwest and West with centers of trade and commerce and the War Department in Washington.

The problem of collecting and distributing meteorological information was solved by the organization in 1871 of the circuit system whereby the Western Union Telegraph Co. set aside certain trunk lines connecting the larger cities of the territory east of the Rocky Mountains with Washington, D. C., for the exclusive use of the Weather Service for such time as was required each day.

The establishment of military telegraph lines connecting military posts with the then outposts of civilization was based on the necessity of protecting frontier settlements from the outbreaks of hostile Indians and lawless men. In the early seventies the frontiers were found in the present States of Arizona, New Mexico, Texas, the Dakotas, Montana, Colorado, Wyoming, Idaho, and Washington. In each of these States telegraph lines connecting military posts with each other and the outside world were constructed and operated by the Army Signal Service. At many of the posts a regularly instructed Signal Service man was in charge. It was his duty, moreover, to make at least three meteorological observations daily and telegraph them to the Washington office. At the peak of the period of military telegraph-line construction there were as many as 111 military telegraph stations in operation and at 68 of them full meteorological observations were made and telegraphed daily.

The eastern seaboard of the United States constituted a frontier of a different character, viz, that of isolation, except at a very few points, as regards communication by the electric telegraph; it was moreover, subject to severe and dangerous storms during which the perils of navigation were greatly increased. In the early seventies the necessity of linking the coastal stretches with the commercial telegraph systems of the country was an outstanding problem for the Army Signal Service. A beginning was made in New Jersey where the first unit of what was for many years known as the "sea coast" line was constructed between Seaville and Pecks Beach, N. J., a stretch of but 10 miles. Immediate steps then were taken to construct a line along the beach of the New Jersey coast from Sandy Hook to Cape May Point and later to extend that line to Smithville, N. C. The line was finished in about a year and functioned successfully for many years; the section from Cape Henry to Hatteras, N. C., now transferred to the Coast Guard was a part of the original construction. The line was operated directly from the signal office in Washington, D. C., and had for its purpose the display of storm warnings in the interest of coastwise as well as of across-seas traffic. Another factor in its use was the succor of vessels in danger of foundering or in distress. Communication between ship and shore was had by means of the international signal flags and by visual signalling in the rare cases when a Signal Service man boarded a vessel in distress and wished to communicate with shore.

Military telegraph lines in the interior, as from time to time, authorized by Congress were for the most part constructed by troops detailed for that purpose. Among the first, if not the very first line so constructed, was one joining San Diego, Calif., by way of Fort Yuma and Maricopa Wells, Ariz., with Prescott and Tucson. This construction was followed by a survey and preliminary work looking to the building of lines connecting military posts in Texas, of which at that time there were 10 or 12. Some of them were along the Texas-Mexico boundary, one was in the Texas Panhandle and others were more or less distant from the advance posts of settlement. To connect these points and other places along the border required a greater outlay of time and labor than had hitherto been expended in any single State.

Concurrently with the activity in Texas, building new lines and extending those already built both in Arizona and New Mexico also in the far Northwest was being carried on.

The longest stretch of line when single units were joined together was that extending from San Diego, Calif., to Denison, Tex., as an eastern terminal. The present writer, when stationed at the last-named point in 1879, well remembers making a number of attempts to work with San Diego, but without success due, no doubt, to the poor insulation of the line in places. Ordinarily the attempt to work long stretches of the military lines as a single circuit was not made. The Texas lines of a total length of more than 1,500 miles were operated as a single circuit three times daily in the collection of meteorological reports from the stations on those lines. At other times they were operated as two or three separate circuits.

Several causes were responsible for the gradually dwindling mileage of the military telegraph lines from its peak of 5,114 miles in 1882 to 1,025 miles in 1891. These causes, named in the order of their importance were, (1) appeals to Congress for increased appropriations for their maintenance were only partially realized, (2) the custom of detailing enlisted men from the Regular Army as operators and linesmen failed in 1883, (3) the abandonment of military posts naturally resulted in the sale or dismantling of the line if local interests were not sufficiently great to warrant its maintenance as a private venture.

In 1883, the year after the peak was reached 2,450 miles of line were sold or abandoned and eight years later when the meterological activities of the Army Signal Service were transferred to the newly created Weather Bureau in the Department of Agriculture but 1,025 miles of the original 5,114 remained. Only those sections that were vital to the meteorological service were continued in use by the Weather Bureau. The new construction by that bureau amounted to a total of 270 miles of land lines and submarine cables; that mileage plus the 629 miles inherited from the Signal Corps makes a total of 899 miles all of which has now been disposed of either by sale or transfer as noted in the beginning of this article.

# EFFECT OF CLOUDS ON THE SURFACE TEMPERATURE

551.576 : 551.524

By W. J. HUMPHREYS

Obviously the radiation emitted by and from any portion, large or small, of the surface of the earth tends to come into equilibrium with the radiation simultaneously absorbed by the same surface. Clearly, too, this exchange, though generally equal only twice in the course of a day and night, would, on the average, balance perfectly (neglecting the minute supply of heat from the interior of the earth) if there were no conduction to and from the atmosphere, nor vertical or horizontal motion—convection and advection—of the air or the oceans, nor evaporation or condensation. But all these things do occur and they greatly disturb the radiation balance. However, they are roughly the same whether the sky be clear or cloudy, and therefore may be disregarded in computing a first approximation to the effect of clouds on the surface temperature.

The rate of emission per unit projected, or minimum inclosing, area is a function of the material and mechanical condition, rough or smooth, of the surface (reentrant angles producing a closer approach to the full radiation) its temperature (directly proportional, nearly, to the fourth power of the absolute temperature), and to the barometric pressure, varying directly as the square of the refractive index of the adjacent air. This latter effect is negligible, since the refractive index in question differs very little from unity. The rate of this radiation does not, however, depend at all on the state of the sky, such as clear or cloudy.

On the other hand, the rate of absorption by the given radiating surface does depend, and very greatly, on the state of the sky owing to the consequent large variations in the amount of incident radiation that might be absorbed. It also, like emission, is a function of the material and condition of the surface and of the barometric pressure.

In general, except as prevented by winds, convection and evaporation, the temperature of the surface tends rapidly to become such that emission is equal to absorption. Furthermore, the greater the rate of incident radiation the greater, in substantially the same ratio, the rate of absorption and the higher the surface temperature.

Let—

$S$ = the net radiation received (incoming less outgoing) per unit horizontal area during a clear night.